Title: Orthorhombic Nanoscale Zirconia as a High Temperature Ceramic for Power Applications

Principal Investigator:

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Zirconium oxide (zirconia) is one of the more promising ceramic thermal barrier materials under development. It is relatively low cost, corrosion resistant, and refractory, making it suitable for high temperature metal coatings. In its pure form, however, it undergoes a 2-3% volume change associated with a crystalline tetragonal to monoclinic phase transition at approximately 1200^{o}C, causing cracking and structural failure. This is generally mitigated by the introduction of a stabilizing agent such as yttria to prevent the phase transformation; yttria, however, is attacked by sulfur in combustion systems, again leading to destabilization, degradation, and failure.

At very high pressures, the equilibrium crystal phase of zirconia shifts to the orthorhombic. Thermal cycling of this material under elevated temperature conditions produces an orthorhombic to tetragonal transformation, thereby *avoiding* the tetragonal-to-monoclinic transformation and the associated crack-inducing volume change. This suggests that pure zirconia could be used as a corrosion resistant ceramic coating, if the orthorhombic phase could be isolated and maintained under the ambient pressure, thermally variable environment of a coal-fired power system.

In this University Coal Research project, nanoscale zirconia will be synthesized in the metastable orthorhombic phase. Initial efforts are focusing on sol-gel pathways to produce this material; later efforts will utilize a novel combustion aerosol process that produces nanoscale materials in a low cost flame based system. Target particle sizes are in the nanometer size range.

Personnel Supported by Grant: Miriam Leffler, post-doctoral research associate

Publications to date: none

Period of Performance: project inception delayed to 4/1/98 due to availability of personnel